

**1** Testing concept emulating

operating conditions, source: IDOM

**2** Pitch bearing for durable operation in wind

turbines under highest loads; source: IMO

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## ACCELERATED BEARING TEST

Standard practice for designing wind turbine blade bearings is dimensioning, which is largely based on experience. The operating conditions in this rotating union present a particular challenge for the rolling bearings used. Their design works as long as no major changes are introduced to the bearing structure or type of bearing loads. Common standards for determining bearing life (ISO 281) and certification guidelines fall short in this respect. The condition of the bearing which is not visible from outside is determined by measuring the thickness of the lubrication film during operation.

### Aims

In the research project HAPT (Highly Accelerated Pitch Bearing Test) the pitch, yaw and main bearing manufacturer IMO, the Institute for Machine Design and Tribology (IMKT) of Leibniz Universität Hannover and Fraunhofer IWES are developing the basis for a computational design, which cleverly combines theory, design and validation. A key aspect is to define the system limits for observing the working condition broadly since the compo-

nents surrounding the bearing as well as pitch system control have a significant influence on the mechanisms of damage and thus on the life of a wind turbine.

### Testing strategy

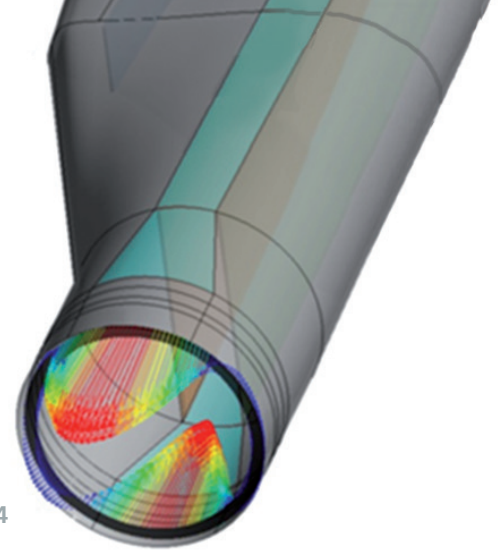
For validating theories of life-limiting states and accelerated test methods, Fraunhofer IWES is setting up a large-scale test bench for current and future generations of turbines up to 10 MW. The test bench concept focuses on the stiffnesses of the attachment parts hub and blade, load application in the bearing as well as new control methods such as IPC. The condition of the bearing which is not visible from outside is determined by measuring the thickness of the lubrication film during operation.

In addition to the large-format bearings, smaller-scale tests validate the theoretical findings. Commissioning of the test infrastructure is scheduled for 2018. After that, several endurance tests on actual-size pitch bearings are planned for a period of two years.

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by the German Bundestag



### Technical Data

- Bending moments up to 50 MNm
- Bearing diameter up to 5 m
- Pitch activity
- Simultaneous test of two bearings
- Accelerated test procedure
- Emulation of the stiffnesses of hub and blade

By simulating the real installation situation, different load scenarios and reproducible conditions can be emulated and blade bearings tested in various operating modes: dynamic application of load in five degrees of freedom, pitch, interim inspections.

The effects of control concepts on bearing life can be checked and repeated any number of times. The reliability and availability of wind turbines can be increased, and costs reduced, as a result.

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### Services

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- Functional testing during development
- Validation of FE models
- Validation of prototypes in continuous operation
- Supplier qualification (2nd source)
- Qualification of alternative bearing constructions
- Risk mitigation

**3** Assembly of a bearing for a turbine with Individual Pitch Control. Photo: IMO

**4** Standardized load distribution of a blade root.